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ABSTRACT

A corollary of the principle that reading comprehension depends on language comprehension is that word skill plus language comprehension skill produces reading comprehension skill. This corollary points to word decoding as being the major source of differences in skilled reading. Various data supporting this claim have been collected from measuring vocalization latency, latency of same-different judgments to letter strings, decision times to judge whether printed words name orally presented targets, time to decide whether a word target is present in a word string, time to decide whether a semantic target is present in a word versus a picture, and time to decide whether a string of words contains a semantic target. In addition, it has been found that differences between reader groups have been largest when production was required and when a semantic decision was required. These facts all suggest the conclusion that speed of accessing the phonological representation of a word is a major skill component differentiating readers. (JM)

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Reading Comprehension depends on Language Comprehension

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I had originally intended, for this symposium, to argue that reading comprehension depends on language comprehension (as my title implies). There are logical and empirical grounds for claiming an intimate relationship between comprehension of speech and comprehension of print and that the notion of understanding language is basic for both speech and print processes. I have changed my mind, however; not about the basic principle but about the need to argue for it. I have done so recently (Perfetti, 1975; Perfetti & Goldman, 1976) and even more recently, 15 minutes ago to be exact, in an AERA paper session in reading and language. Others (e.g., Sticht, 1976) have also argued for this principle. For purposes of this symposium I simply reassert the principle and claim that it is true in certain fairly specific ways. I turn instead to a corollary of this principle.

The Coding Corollary of the RCDOLC Principle

The corollary is that if reading comprehension depends on language comprehension, then word decoding skill plus language comprehension skill = reading comprehension skill. The decoding principle becomes important: skilled readers differ from unskilled readers in their speed of simple word decoding. This is the major source of differences in skilled reading.

I will now present some data that support this claim.

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Slide 1 about here.
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The first set of data show the basic relationship between decoding speed and comprehension. They show that children classified as skilled are faster than children of the same age classified as less-skilled in speed of single word decoding. This difference is greater for words of 2 syllables than for words of one syllable. Further, it is greater for pseudo words than for real English words. Conclusion--Differences in reading skill are traceable to degree of subword decoding skill.

How about meaning? The fact that differences are larger for pseudo words (words without meaning) than for words with meaning suggests that phonological coding is at the heart of the matter. That is, that basic print-sound correspondence are more rapidly (automatically) activated for skilled readers and that this is the source of reading skill differences. The basis for asserting the causal relationship is conceptual not empirical. The necessary link that fast decoding leads to improved comprehension has not been made. Rather the theoretical assumption that coding operations which are not automatic share limited processing resources with other comprehension work. Thus fast (automatic) decoding facilitates comprehension directly in affecting other components of comprehension.

With respect to meaning there are two distinct possibilities. One is that skilled readers differ from unskilled readers only in phonological decoding. Some aspects of word meaning "come free" with this decoding. Thus meaning is "automatic" given decoding. Differences between skilled and unskilled readers are confined to decoding. Any observed differences in semantic access are accounted for by differences in phonological decoding.

The alternative hypothesis says that skilled readers differ from unskilled readers in both types of coding process. There will be differences

in semantic coding that are not accounted for by differences in phonological coding. Meaning access may or may not be automatic but meaning use is not automatic.

There are grounds for favoring either view consistent with the basic assumption that skilled reading comprehension depends on rapid word recognition. It is especially compelling to assume that differences in access to word meanings are accounted for by differences in access to word names; i.e., that difference between skilled and unskilled readers on semantic decoding is equal to their difference in phonological decoding. The "linguistic" view of reading has made this assumption. Once the reader has converted print into the name of a word he will have been successful at reading, assuming that the meaning of the word is known to him.

On the other hand, the rapid use of meanings may be something different. In a recent experiment, we presented single words and single pictures to 10 year old readers divided into two levels of reading skill based on performance on the reading part of the Durrell. The low-skilled readers were thus children whose reading level was not up to their listening level. Subjects had two different decision tasks to perform. In one task (matching), the subject decided whether each of a block of stimuli matched an orally presented target. For example, in the picture condition, the experimenter said the word "rabbit" and a slide then exposed a picture of a rabbit or a picture of something else. In the word condition, the word "rabbit" or some other word was seen. To minimize any interference effect the target remained the same for blocks of 8 trials. Furthermore, non-target stimuli were never instances of the same category as the target word.

In the other task (categorization), the subject decided whether each stimulus was or was not an instance of a target category. There were two target categories, animals and foods, and the instances were common members of the category used in the matching task. The semantic target was the same for a block of 16 stimuli. Notice that the subject was not asked to decide whether a stimulus belonged to one category or another. We wanted the task to be as free as possible of decision factors involving comparisons. Furthermore, noncategory members were not instances of the alternate categories.

Thus this experiment gives a needed comparison, Phonological Coding versus Semantic Coding. In fact the matching task may be the prototypical phonological coding task. It measures how long it takes a reader to decide for example that D-O-G is /dawg/. Of the several speed-of-decoding tasks we have used, this one seems to have the least extra processing. As for Semantic Decoding, if any form of meaning comes free with phonological decoding, it should be the salient superordinate categories we used in this experiment. Thus the prediction of Automatic Semantic Access is that the difference between skilled and unskilled readers for the Categorization Task equals their difference on the Matching Task.

A summary of results for same judgments are in the next slide (Table 1). Less-skilled readers were not different from skilled readers in picture matching and are only 45 milliseconds slower in word matching. However, in word categorization, less-skilled readers are 156 milliseconds slower. Using a subtractive logic, this suggests that skill difference in phonological decoding are 45 milliseconds and differences in semantic decoding are 111 milliseconds.

While all of these differences are small, they clearly are not compatible with the hypothesis that meaning comes free with decoding, especially for unskilled readers. Word categorization cost an extra 101 milliseconds for a skilled reader, but an extra 212 milliseconds for a less-skilled reader. It is worth repeating that the category task exploited well practiced semantic relations. For these 10-year old subjects, it is not a question of semantic knowledge but of semantic use.

This description might appear to be at odds with data of Golinkoff and Rosinski (1975). (I believe Golinkoff will describe the task in this symposium.) In their experiment, a picture naming task was presented to third and fifth grade children classifiable as skilled and unskilled readers. Rosinski, Golinkoff and Kukish (1975) had earlier found that this picture naming was subject to a semantic interference effect, such that total picture naming speed for a large set of pictures on a page is slowed down when words are printed on the pictures. The interference is semantic, because the effect apparently depends on picture name and word name being from the same semantic category, e.g., The word 'pig' printed on a picture of a cow. In the Golinkoff and Rosinski (1975) experiment, skilled readers showed a semantic interference effect no greater than unskilled readers. They concluded that the relevant semantic information areas compellingly with a word stimulus even for unskilled readers. My belief in this description is slightly altered by the data I have presented. It may indeed be true that semantic access is an automatic part of decoding, but when the reader has to use that semantic information, as in reading, there is a disadvantage for the less-skilled reader.

We have additional evidence that suggests slower semantic decoding in less-skilled readers. In these experiments subjects had search tasks based on semantic targets (is there an animal?) and word targets (is there "dog?"). Set size varied from 1 to 7 and half the trials had a target. The results are somewhat complex with respect to negative and positive responses, but skilled readers were generally faster at both the semantic category task and the word matching task than were unskilled readers. For correct negative responses, i.e., for correct responses when targets were not present, differences between reader groups were much larger for the semantic category task than for word matching. For positive responses, i.e., correct responses when a target was present, reader differences were equal for the two tasks. It may be fair to assume that more semantic work is required for a correct negative response than for a correct positive response. For the less-skilled, rapid use of semantic information may suffer in proportion to the amount of semantic work to be performed. However, further research is needed to clarify this aspect of semantic doing. For now, a tentative conclusion is that the rapid use of semantic information may be a problem for some low-skill readers in some conditions, over and above phonological decoding.

One final piece of data in this regard comes from this last task. Subjects received a surprise forced-choice recognition test following one of their matching tasks and following one of their categorization tasks. The items were all non target items that the child had just been exposed to. Figure 2 shows the surprising results.

Following matching, the recognition memory for non-target items is only at chance for low-skill readers. After categorization, it actually

exceeds the recognition memory of the high-skill readers. Low skill readers are not getting much useful information about words in the decoding task. By contrast, skilled readers are getting about as much useful information as during categorization. This is what one might expect from the view of coding I have been suggesting. If a reader is not good at basic phonological coding, useful semantic information may not automatically accompany successful decoding. If he is good at it, decoding and semantic coding may go hand in hand.

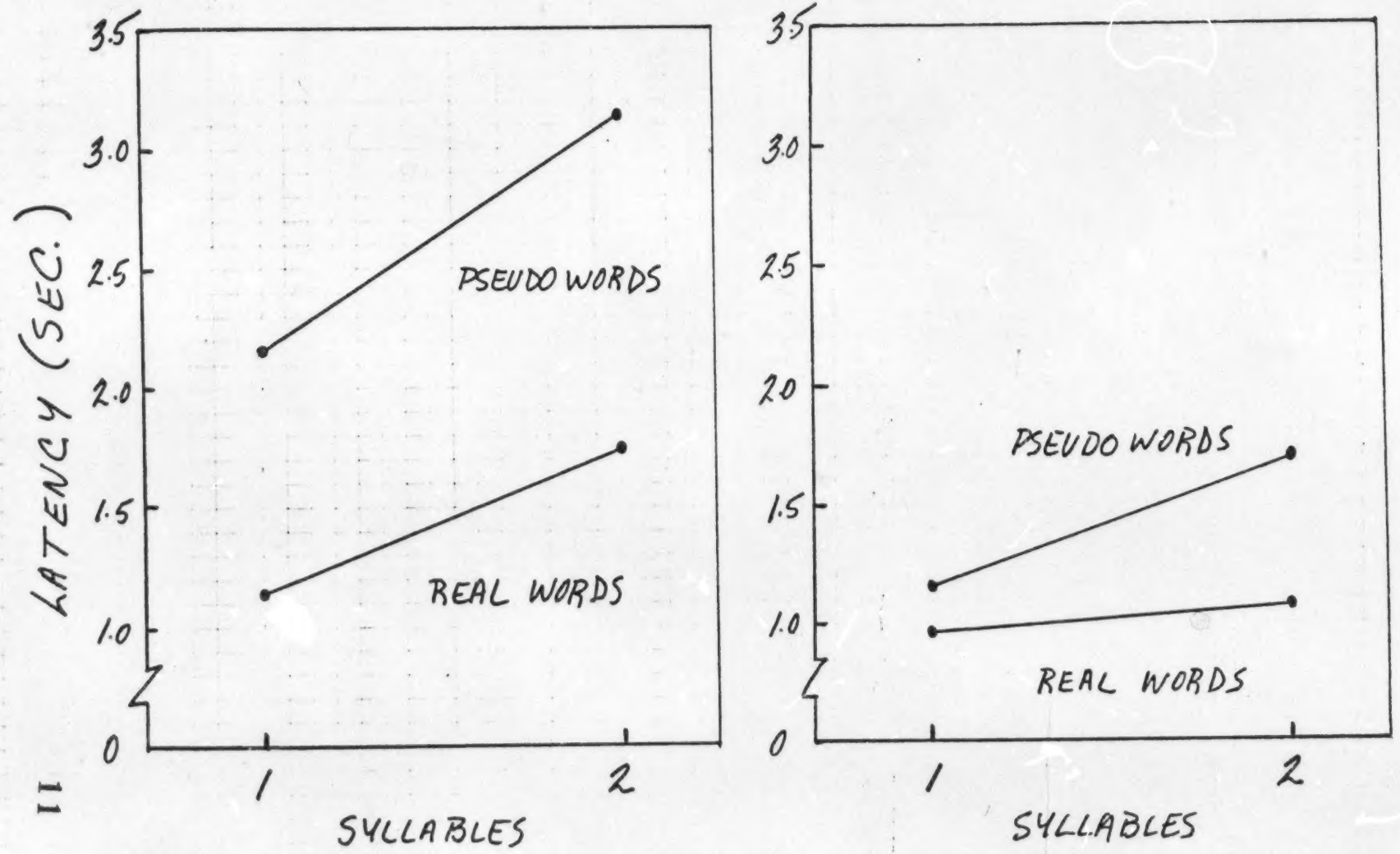
Conclusion

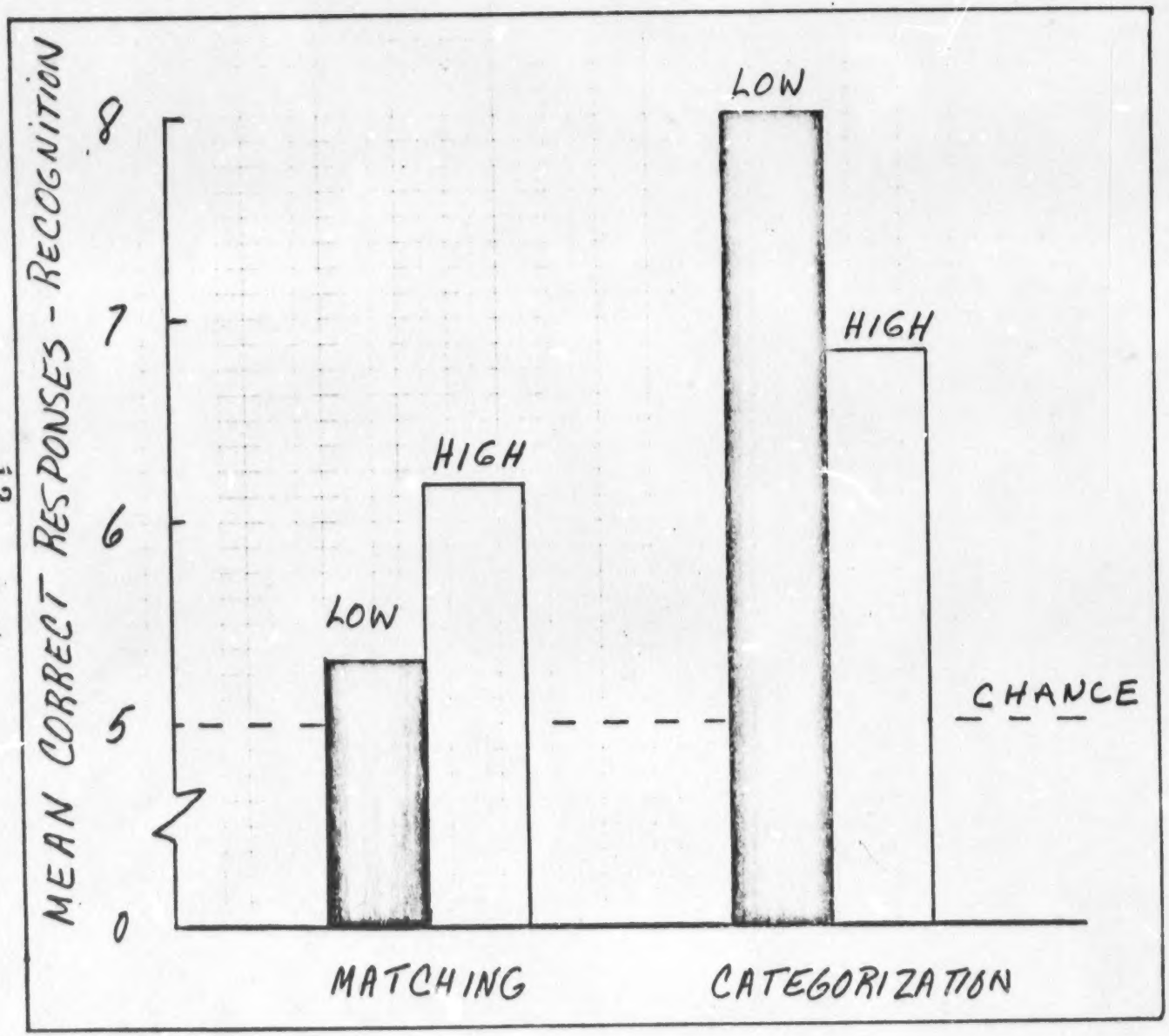
My research with "good" and "poor" readers has led to increasing complexity with respect to simple explanations of reader differences. In the case of simple word decoding, we have measured (a) vocalization latency, (b) latency of same-different judgments to letter strings, (c) decision times to judge whether printed words name orally presented targets and (d) time to decide whether a word target is present in a word string, and (e) time to decide whether a semantic target is present in a word vs. a picture and (f) time to decide whether a string of words contains a semantic target. Differences between reader groups have been largest (1) when production was required and (2) when a semantic decision was required. I think these facts suggest the conclusion that speed of accessing the phonological representation of a word is a major skill component differentiating readers. Tasks which can be performed only with visual, graphemic and orthographic features, are less distinguishing. Semantic use is also slower, although this particular fact may escape notice in some tasks, just as decoding differences can escape notice if the criterion is reading words off the Wide Range Achievement Task. In both cases criteria of mastery may have to include measures of speed if

we are not going to overestimate the basic skills that unskilled readers have. This is important practically, because we might want to make sure that basic skills are acquired to a very high level before we begin to suppose that defective fancier comprehension skills are the source of problems for the unskilled reader.

Table 1

	Pictures	Words	
High Skill			
Matching	833	838	(835.6)
Category	772	939	(855.5)
	(802)	(889)	(845.6)
Low Skill			
Matching	831	883	(857)
Category	875	1095	(985)
	(853)	(989)	(921.1)


LOW SKILL
HIGH SKILL
LATENCY (SEC.)
3.5
3.0
2.5
2.0
1.5
1.0
0
PSEUDO WORDS
REAL WORDS
1
2
SYLLABLES


MEAN CORRECT RESPONSES - RECOGNITION
8
7
6
5
0
LOW
HIGH
LOW
HIGH
CHANCE
MATCHING
CATEGORIZATION